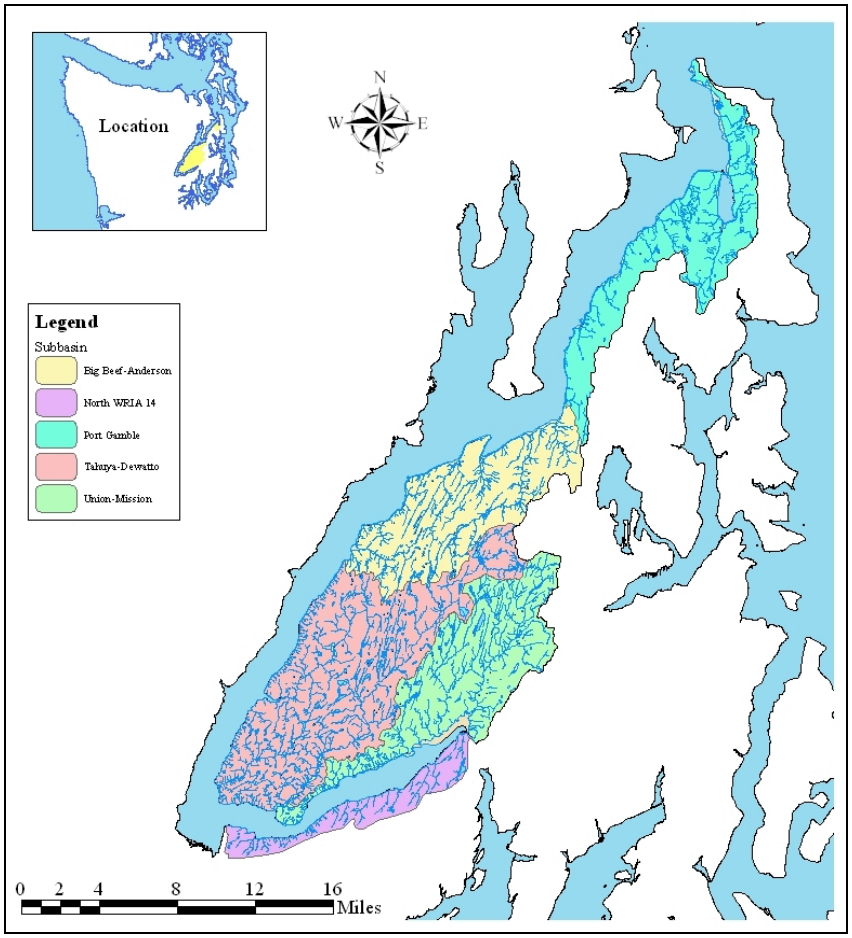
Washington State Conservation Commission

# SALMONID HABITAT LIMITING FACTORS WATER RESOURCE INVENTORY AREAS 15 (WEST), KITSAP BASIN AND 14 (NORTH), KENNEDY-GOLDSBOROUGH BASIN




**FINAL REPORT**
**JUNE 2003**

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# ACKNOWLEDGEMENTS

Coho salmon preparing to spawn in a tributary of the Tahuya River.
Photo courtesy of Marty Ereth, Skokomish Tribe.

The Water Resource Inventory Areas 15 (West) and 14 (North) salmonid habitat limiting factors report could not have been completed without considerable contributions of time, data, and effort from the following people who participated in various capacities on the Technical Advisory Group (TAG):

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The author also wishes to thank: Ron McFarlane (Northwest Indian Fisheries Commission) for compilation of the maps for this report; Jennifer Cutler (Northwest Indian Fisheries Commission) and Ginna Correa (Washington State Conservation Commission) for assistance with mapping of fish distribution and fish passage barriers; Ed Manary (Washington State Conservation Commission) for authorship of the "Salmonid Habitat Limiting Factors Background" section, and for providing the extensive array of computer hardware, software, and other resources necessary to develop this report, and Marty Ereth (Skokomish Tribe) and the Allyn Salmon Enhancement Group for contributing photographs for use in this report.

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# ABBREVIATIONS AND ACRONYMS

‰: Parts per thousand
7-DADMT: Seven-day average daily maximum temperature
AIMT: Annual instantaneous maximum temperature
CFS: Cubic Feet per Second
CREP: Conservation Reserve Enhancement Program
CRP: Conservation Reserve Program
DBH: Diameter at Breast Height
DO: Dissolved Oxygen
DOE: Washington Department of Ecology
EQIP: Environmental Quality Incentives Program
ESA: Endangered Species Act
FSA: Farm Service Agency (USDA)
GPM: Gallons per Minute
HCCC: Hood Canal Coordinating Council
HCSEG: Hood Canal Salmon Enhancement Group
IFIM: Instream Flow Incremental Methodology
KCD: Kitsap Conservation District
LB: Left Bank of stream (looking downstream)
LWD: Large Woody Debris
MCD: Mason Conservation District
NRCS: USDA Natural Resource Conservation Service (formerly SCS)
NMFS: National Marine Fisheries Service
NWIFC: Northwest Indian Fisheries Commission
PNPTC: Point No Point Treaty Council
RB: Right Bank of stream (looking downstream)
RCW: Revised Code of Washington
RM: River Mile
SASSI: Salmon and Steelhead Stock Inventory (WDFW 1992)
SaSI: Salmonid Stock Inventory (WDFW 1998-present)
SID: Washington Department of Fisheries, Stream Improvement Division
SSHIAP: Salmon and Steelhead Habitat Inventory and Assessment Project (NWIFC)
SRFB: Washington State Salmon Recovery Funding Board
TSS: Total Suspended Solids
USACE: United States Army Corps of Engineers
USDA: United States Department of Agriculture
USFS: United States Forest Service
USFWS: United States Fish and Wildlife Service
WAC: Washington Administrative Code
WAU: Watershed Administrative Unit
WCC: Washington State Conservation Commission
WDF: Washington Department of Fisheries
WDFW: Washington Department of Fish and Wildlife
WHIP: Wildlife Habitat Incentives Program
WRIA: Water Resource Inventory Area

# EXECUTIVE SUMMARY

## Introduction

This report describes and assesses riverine and nearshore salmonid habitat conditions along the east shore of Hood Canal (west Water Resource Inventory Area, WRIA 15), and the south shore of Hood Canal (north WRIA 14). This region extends from Foulweather Bluff in the north to the town of Union in the south. The report focuses on salmonid habitat conditions only; harvest, hatchery, and hydropower issues, while playing a part in the decline of salmonid populations, will not be discussed. These issues are being dealt with in other forums. In 1998, the Washington State Legislature passed Engrossed Substitute House Bill 2496 (later codified to RCW 77), directing the Washington State Conservation Commission in consultation with local, state, federal, and tribal agencies to identity habitat factors that limit salmonid production in watersheds throughout Washington State. This report was developed under this mandate and is intended for use in identification and prioritization of salmonid habitat restoration and protection projects within the report area. The report is not a salmonid habitat recovery strategy, although it could be a component of such a plan.

## Habitat and Salmonid Production

The ecological characteristics of streams draining to the east and south shores of Hood Canal are largely the product of past glaciations. The topography of this area is relatively flat and dissected by numerous streams eroding sediments deposited and reworked by several glacial episodes. Numerous lakes and wetlands are present in depressions throughout the drainage network, providing important rearing habitat for juvenile salmonids, particularly coho salmon and cutthroat trout. The glaciers deposited large quantities of gravel that provide abundant salmonid spawning habitat in the low to moderate gradient streams draining this region. Groundwater travels freely through gravel lenses, maintaining streamflows during the dry summer months, and improving conditions for developing juvenile salmonids buried in the streambed during the winter and early spring. The forests that carpet this region stabilize streambanks, cool streams through shading, and provide large woody debris, which creates pools and complex instream habitat needed by both juvenile and adult salmonids. Hood Canal is host to a complex network of mudflats, dendritic tidal channels, lagoons, salt marshes, eelgrass beds, and sandy beaches that provide estuarine habitat for both juvenile and adult salmonids as well as the prey they depend upon.

## Salmonid Species Present

Four species of Pacific Salmon and two species of trout are present within the report area. Salmon species include summer and fall chum *(Oncorhynchus keta)*, coho *(O. kisutch)*, fall chinook *(O. tshawytscha)*, and pink *(O. gorbuscha)*. Winter steelhead *(O. mykiss)*, and coastal cutthroat *(O. clarki clarki)* are the two trout species present. Each of these species employs a slightly different life history to make maximum use of available habitat, while minimizing habitat competition between the species. All of the salmonids

discussed in this report display some degree of anadromy, reproducing in freshwater and growing and maturing in saltwater. All of the Pacific Salmon reproduce in freshwater and migrate to sea. Steelhead and coastal cutthroat display varying degrees of anadromous behavior. Some steelhead residualize and spend their entire life in freshwater (referred to as rainbow trout). Similarly, some coastal cutthroat trout make short forays to saltwater, but many cutthroat don't migrate to sea at all. Resident coastal cutthroat are the most widely distributed salmonid within the report area. They are present in nearly every fish-bearing stream reach, particularly above barriers to anadromous migration. All four of the salmon species present spawn during the fall and early winter months, while steelhead and cutthroat are spring spawners. The life histories employed by these salmonids place them in some portion of the freshwater and marine environments within the report area throughout the calendar year. Although an anadromous life history allows salmonids to exploit both freshwater and marine habitats, it also makes them vulnerable to human-alterations in both of these environments.

**Salmonid Stock Status**

Summer Chum Salmon

For management purposes, Hood Canal summer chum are divided into the Hood Canal and Union River stocks. As a whole, escapements of Hood Canal summer chum have declined to critically low levels. The escapement goal was met only three times from 1968 to 1991. Hood Canal summer chum are not directly targeted in fisheries, although they are caught incidentally in Canada, the Strait of Juan de Fuca, northern Puget Sound, and terminal areas of Hood Canal (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994). The National Marine Fisheries Service listed Hood Canal summer chum salmon as a threatened species under the Endangered Species Act in March 1999 (National Marine Fisheries Service 1999a, Ames *et al.* 2000). Summer chum were historically present in Big Beef Creek, Anderson Creek, the Dewatto River, and the Tahuya River. These stocks are now extinct. In contrast, the Union River supports a "healthy" summer chum stock (Washington Department of Fish and Wildlife 2003). A large and relatively intact estuary at the mouth of the Union River and releases of cold water from the Union River Reservoir during the late summer months likely aid summer chum production in this watershed (TAG 2003).

Fall Chum Salmon

Fall chum spawning in streams on the east shore of Hood Canal are classified in three stocks: Northeast Hood Canal fall chum, Dewatto fall chum, and Southeast Hood Canal fall chum. Substantial hatchery supplementation has taken place in streams on the east shore of the Canal. All three of these stocks are considered composites of hatchery and wild fish. Hood Canal fall chum are harvested in many commercial and recreational fisheries ranging from Vancouver Island to the terminal area in Hood Canal. Fairly large numbers of fall chum are present in all Hood Canal streams. The status of all three of these stocks was rated "healthy"(Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994, Washington Department of Fish and Wildlife 2003).

Coho Salmon

Coho spawning in this region are divided into three stocks: Northeast Hood Canal coho, Dewatto coho, and Southeast Hood Canal coho. Substantial numbers of hatchery-origin coho have been released into Hood Canal. The effects of these plants on wild salmon are unknown. All Hood Canal coho stocks are characterized as composites of native and non-native stocks because of the hatchery operations on the Canal. Stocks are identified based on geographic separation. The status of all three of these stocks was rated "depressed" in the early 1990s (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994). However, escapements improved substantially in the following decade, resulting in an upgrade to "healthy" status in 2002 (Washington Department of Fish and Wildlife 2003).

Fall Chinook Salmon

A small number of chinook spawn in the Union and Tahuya Rivers. Chinook enhancement programs operated by the WDFW, USFWS, and the tribes have influenced the genetic integrity of Hood Canal chinook populations. Hood Canal chinook have been combined as one aggregate stock because of interbreeding of hatchery and wild fish (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994). The primary management objective for Hood Canal chinook is attainment of hatchery escapement goals, resulting in a high harvest rate of wild chinook commingled with hatchery chinook. From the late 1960s to the early 1990s, naturally spawning Hood Canal chinook have generally not met escapement goals. Returns to southeast Hood Canal streams, primarily the Dewatto, Tahuya, and Union Rivers, were below the escapement goal of 400 spawners (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994). The 2002 SaSI update did not discuss chinook salmon status in watersheds included in this report.

Pink Salmon

Small numbers of pink salmon are present in west WRIA 15. Stock status of these runs was not discussed in Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes (1994) or Washington Department of Fish and Wildlife (2003).

Winter Steelhead Trout

Winter steelhead are present throughout this region, but the Dewatto, Tahuya, and Union Rivers are the main production areas. Low summer flows are the primary natural limiting factor of winter steelhead in these watersheds. Winter steelhead smolts have been stocked in the Dewatto and Tahuya Rivers and nearby streams, but the effects on native steelhead populations are unknown (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994). The stock status of winter steelhead in the Dewatto, Tahuya, and Union Rivers was characterized as "depressed" in the early 1990s and 2002 (Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes 1994, Washington Department of Fish and Wildlife 2003).

Coastal Cutthroat Trout

Both anadromous and resident coastal cutthroat are present in the East Hood Canal stock complex. The year 2000 SaSI Coastal Cutthroat Trout report characterized the stock status of East Hood Canal coastal cutthroat as "unknown." Long-term monitoring information was insufficient to assess the stock status (Blakley *et al.* 2000).

**Effects of Land Use on Salmonid Habitat Conditions**

Riverine Habitat

The east and south shores of Hood Canal are drained by numerous streams. Euro-American settlement of the Hood Canal region necessitated development of a transportation system. Numerous road crossings of streams were necessary to implement an effective road system. In some cases, little consideration was given to maintaining anadromous fish passage at road crossings, while in other cases, changes in stream character created a barrier at a once passable road crossing. Fish passage barriers are widely distributed throughout the report area, particularly on small independent tributaries.

Floodplains are often times attractive areas for agricultural or residential settlement because of their fertile soil and flat slope. Development on floodplains has resulted in conflicts between protecting property and infrastructure from flood damage, and maintaining natural floodplain functions. With the exception of large streams such as the Dewatto, Tahuya, and Union Rivers, floodplain habitat is generally present along only a small portion of the lower reaches of streams. Floodplain habitat has been impacted to some extent throughout the report area. Roads adjacent to the Hood Canal shoreline, particularly State Route 106 and Northshore Road have significantly altered floodplain habitat at the mouths of streams.

Timber harvest, agriculture, and residential and commercial development have substantially altered salmonid habitat throughout west WRIA 15 and north WRIA 14. Logging of oldgrowth forests began in the mid-1800s, with timber cut at a voracious pace. By the 1930s-1940s, entire watersheds had been denuded by logging and out-of-control wild fires. Historic logging practices included removal of trees within the riparian zone and removal of large woody debris (LWD) from streams to ease transport of logs (Amato 1996). Logging of riparian timber would have severely reduced or eliminated recruitment of LWD, reduced shade needed to maintain cool stream temperatures, and left streams susceptible to soil erosion from the surrounding uplands. Removal of LWD would have reduced pool abundance, size, and quality, and destabilized streambeds, leading to loss of spawning substrate. After the original logging was completed in the early 1900s, many stream channels were left clogged with logging slash, potentially obstructing fish passage. In 1951, the Washington Department of Fisheries created the Stream Improvement Division (SID) to correct this situation. The SID conducted extensive stream cleanout projects in Hood Canal streams until 1970. Private citizens also conducted woody debris removal and channel modification projects (Amato 1996).

Fortunately, watersheds throughout the basin have recovered from much of the damage caused by the original logging operations and stream cleaning efforts. Second growth forests now cover the majority of the area. These forests sustain the commercial forest products industry, which remains the dominant land use within the report area. Fine sediment is a limiting factor in only a small portion of the basin, particularly in the northern portion of the Port Gamble Subbasin. Large woody debris is lacking in many watersheds, particularly so in the Port Gamble and Big Beef-Anderson Subbasins. Woody debris levels are moderate to high in the Tahuya-Dewatto, Union-Mission, and North WRIA 14 Subbasins. Pool habitat is limited in many watersheds, particularly in watersheds with low LWD abundance. Streambanks are generally stable in the majority of watersheds assessed.

Roads intercept precipitation, leading to increased stormwater runoff and erosion. Roads also have the potential to destabilize hillslopes, leading to landslides that contribute fine sediments to stream channels. A road density of three miles of road per square mile of watershed is the recognized threshold for causing significant impairment of watershed functions. Road densities exceed this level in the vast majority of watersheds within the report area. With the exception of the Stavis, Harding, Anderson, and Thomas Creek Watersheds, mass wasting is not a significant problem.

Historic logging, residential development, agriculture, and the transportation network have all contributed to degradation of riparian habitat conditions in west WRIA 15 and north WRIA 14. Although reduction of riparian stand age and modification of stand composition (coniferous-deciduous ratios) have been widespread, riparian buffers are moderately functional throughout the basin. Water temperature data were sparse throughout the report area. Where data were present, summer water temperatures ranged from poor to good. Degraded riparian conditions, wetlands, and shallow man-made lakes all contributed to high water temperatures. With the exception of the Big Beef-Anderson Subbasin, hydrology information was lacking throughout the report area. No recent instream flow data were located for streams within the report area. Little information was available regarding anadromous salmonid escapement. This is likely the result of a combination of factors including the difficulty of monitoring escapement to a large number of small streams with limited man-power, as well as the practice of grouping salmonid species in large aggregate groups for management purposes (for example coho and fall chum are classified into three "stocks" – Northeast Hood Canal, Dewatto, and Southeast Hood Canal).

Nearshore Habitat

Hood Canal and the Olympic Mountains to the west provide striking scenery and numerous recreational opportunities that make the shoreline a popular site for residential development. Activities associated with shoreline development including filling of intertidal mudflat, salt marsh, and lagoon habitats, shoreline armoring, removal of riparian vegetation, and installation of boat ramps, docks, and piers, have altered natural shoreline processes, particularly recruitment of sediment and woody debris from eroding bluffs and sediment transport and deposition along the shoreline (TAG 2003). In many

cases, productive habitats such as salt marshes, lagoons, and shallow bays have been severely altered or lost (Washington Department of Ecology 2000b, Point No Point Treaty Council 2003, Unpublished work). These habitats provide important rearing areas for juvenile salmonids and transition areas for both juvenile and adult anadromous fish. Losses of these nearshore habitats would be expected to adversely affect salmonid production (TAG 2003).

Surf smelt and sand lance, both important forage for anadromous salmonids, spawn near the high tide line on sand and gravel beaches. In order for these fish to spawn successfully, they need beaches with the appropriate size of substrate and shade provided by riparian vegetation (Penttila 2001). Juvenile salmonids migrate in shallow water along the shoreline to avoid predators found in deeper water and to forage on aquatic invertebrates that live in eelgrass beds and terrestrial invertebrates that fall off of riparian vegetation. Intertidal fill and bulkheads have affected anadromous salmonid production by: (1) reducing recruitment of sediment and large woody debris from bluffs and altering littoral drift of these materials along the shoreline, (2) physically burying forage fish spawning beds, thereby reducing the prey available to salmonids, (3) removing riparian vegetation, leading to reduced forage fish abundance and reduced forage opportunities on terrestrial invertebrates, and (4) forcing juvenile salmonids to migrate off-shore in deep water where they are susceptible to predation (Simenstad 2000).

Numerous roads and highways are located along the Hood Canal shoreline (Washington Department of Ecology 2000b). In many cases, road crossings at stream mouths have constrained stream and tidal channels. These constrictions alter tidal processes and sediment transport, and in some cases interfere with anadromous fish migration (TAG 2003). Shoreline roads have also reduced the width of riparian buffers throughout much of the report area, particularly along the east arm of the Canal (Washington Department of Ecology 2000b). Impervious surfaces associated with roads and other shoreline development have the potential to impair water quality through runoff of contaminated stormwater (TAG 2003).

Continued population growth in the Hood Canal region is inevitable. From 1970 to 2000, the population of Kitsap County increased from 100,000 to 230,000 people (Payne and Froyalde 2001). During this same time period, the population of Mason County expanded from roughly 21,000 to 49,400 residents (Wallace 2002). As the population has grown, conversion of timberlands to rural residential development has become more common (Brody 1991). The pressure to convert timberlands to rural residential land use will likely grow stronger as the population of the Kitsap Peninsula continues to expand. This development trend is likely to negatively impact both riverine and nearshore salmonid habitats. A balance between continued development and protection and/or restoration of natural riverine and nearshore habitat processes must be achieved to promote recovery of anadromous salmonid populations in west WRIA 15 and north WRIA 14 (TAG 2003).

# WEST WRIA 15 AND NORTH WRIA 14 RECOMMENDATIONS

## General Riverine Recommendations

The west side of the Kitsap Peninsula and the south shore of Hood Canal are popular residential development sights because they are relatively secluded from the urban areas of Bremerton, Tacoma, and Seattle while still being within a reasonable commute to these areas. The Canal and the Olympic Mountains to the west provide striking scenery and numerous recreational opportunities that enhance the attractiveness of this area. Historically this region was covered with a vast forest. Logging that began in the mid to late 1800s removed the majority of old-growth forests. Today, much of the report area is still covered by timberlands, the majority of which are privately owned. The Tahuya State Forest, Bremerton Municipal Watershed, and the Bangor Naval Station are the largest blocks of forestland owned by the public.

Conversion of privately owned forestland to rural residential land use has become increasingly common as more people settle in this area. Widespread conversion of forestland to rural residential land use has the potential to cause degradation of riverine habitat conditions. Removal of forest cover is often accompanied by installation of buildings, roads, driveways, and lawns. Rooftops and pavement are impervious to water, causing overland flow and reduced infiltration of precipitation. Lawns have less water holding capacity than forests. During the winter months, rapid stormwater runoff causes abnormally high peak stream flows, damaging salmonid habitat and human infrastructure. In the summer months, stream flows are abnormally low because of reduced aquifer recharge during the wet season.

The shorelines of streams, lakes, and wetlands are popular development sites. Unfortunately development in these areas often leads to removal of forested riparian buffers that provide shade during the summer months and large woody debris critical to maintenance of instream salmonid habitat conditions. Development along shorelines frequently leads to reduced floodplain function through installation of roads and dikes, or stream channelization. Stormwater runoff and wastewater from septic systems can pollute water with hydrocarbons, pesticides, herbicides, fertilizers, fecal matter, and other substances. While future residential development is inevitable, the TAG makes the following recommendations to protect existing habitat and minimize further degradation of riverine habitat conditions:

- Protect watershed conditions by preventing sprawling rural residential development. Encourage private forestland owners to continue timber production in a sustainable fashion that protects natural watershed functions (i.e. natural sediment production rates, natural runoff and stream flow regimes, mature riparian forests with coniferous trees, adequate large woody debris and pool abundance).

- Protect functional riparian forest buffers to provide shade to maintain cool summer stream temperatures, provide large woody debris necessary to maintain

instream salmonid habitat, and filter soil and pollutants from runoff. Where feasible, replant native riparian vegetation at degraded sites.

- Protect functional floodplain habitat and where practical, restore lost floodplain habitat. Prevent further floodplain development. Decommissioning of an old forest road and construction of a new access road on the lower portion of Anderson Creek is one example of a potential floodplain restoration project.

- Protect the shorelines of lakes, ponds, and wetlands that maintain summer stream flows and provide rearing habitat for juvenile salmonids. Where practical, restore degraded shorelines.

- Maintain cool summer water temperatures and fish passage by preventing conversion of wetlands to shallow man-made lakes (for example Lake Symington and Lake Tahuya).

- Remove fish passage barriers.

- Minimize installation of impervious surfaces such as rooftops, roads, driveways, and lawns. Educate the public about the importance of minimizing impervious surfaces.

- Monitor instream flows and water quality parameters including temperature and dissolved oxygen levels throughout west WRIA 15 and north WRIA 14.

- Assess salmonid habitat conditions in the watersheds of the numerous small independent streams in the report area, particularly streams in the Port Gamble Subbasin and streams draining to the north shore (Tahuya-Dewatto and Union-Mission Subbasins) and south shore (North WRIA 14) of the east arm of Hood Canal.

**General Nearshore Recommendations**

The Hood Canal shoreline is a popular site for residential development. Filling of intertidal mudflat, salt marsh, and lagoon habitats, shoreline armoring, removal of riparian vegetation, and installation of boat ramps, docks, and piers, all associated with shoreline development, have altered natural shoreline processes including sediment recruitment from eroding bluffs and sediment transport and deposition along beaches. Shoreline development has also completely eliminated a substantial amount of nearshore/estuarine habitat that historically provided important forage fish spawning beaches and juvenile salmonid rearing and migration areas. Numerous roads and highways are located along the Hood Canal shoreline. In many cases, road crossings at stream mouths have constrained stream and tidal channels. These constrictions alter tidal processes and sediment transport, and in some cases interfere with anadromous fish migration. Shoreline roads have reduced the width of riparian buffers throughout much of the report area, particularly along the east arm of the Canal. While continued shoreline

development is inevitable, the TAG makes the following recommendations to protect existing habitat and minimize further degradation:

- Protect existing functional nearshore habitats including: bluffs, bays, lagoons, salt marshes, spits, mudflats, and native riparian vegetation. Notable examples of each of these habitats include *(ordered from north to south)*:
    - Bluffs:
        - See eroding bluff section below.
    - Bays:
        - Gamble Bay
        - Big Beef Harbor
        - Seabeck Bay
        - Stavis Bay
        - Dewatto Bay
        - Tahuya Bay
    - Lagoons:
        - Foulweather Nature Conservancy Property
        - Lagoon 0.5 miles south of King Spit
        - Nick's Lagoon (Seabeck Bay)
        - Misery Point Lagoon
        - Lagoons between Misery Point and Stavis Bay
    - Salt Marshes:
        - Foulweather Bluff salt marsh
        - Foulweather Nature Conservancy Property
        - Small patches in the Driftwood Key Development (Coon Bay)
        - Mouth of Hawks Hole Creek
        - Point Julia
        - King Spit
        - Mouth of stream 15.0376
        - Mouth of Little Anderson Creek
        - Big Beef Harbor
        - Little Beef Harbor
        - Nick's Lagoon
        - Stavis Bay
        - Hood Point
        - Mouth of Boyce Creek
        - Tekiu Point
        - Mouth of Anderson Creek
        - Chinom Point
        - Mouth of Dewatto River
        - Mouth of Little Dewatto Creek
        - Mouth of Rendsland Creek
        - Mouth of Tahuya River
        - Lynch Cove
        - Mouth of Dalby Creek

- Spits:
  - Foulweather Bluff salt marsh
  - Mouth of Gamble Creek
  - Misery Point
  - Stavis Bay
  - Mouth of Devereaux Creek
- Mudflats:
  - Gamble Bay
  - Big Beef Harbor
  - Little Beef Harbor
  - Seabeck Bay
  - Stavis Bay
  - Dewatto Bay
  - Tahuya Bay
  - Lynch Cove
- Native Riparian Vegetation:
  - Foulweather Bluff salt marsh
  - Foulweather Nature Conservancy property and shoreline immediately to the north and south
  - North shore of Stavis Bay north to Spear-Fir Lagoon
  - Community of Holly south to Bald Point

- Evaluate all road crossings along the Hood Canal shoreline to assess tidal function, sediment transport, and anadromous fish migration, and where necessary, implement corrective actions to restore and/or enhance natural tidal processes, sediment transport, and anadromous fish access.

- Allow eroding bluffs to function naturally to provide the sediment and large woody debris needed to maintain shoreline features such as beaches, spits, and lagoons, and shoreline habitat complexity. Notable eroding bluffs include:
  - Between the Foulweather Bluff salt marsh and the Foulweather Nature Conservancy property
  - Just south of Stavis Bay
  - Just south of the mouth of Boyce Creek
  - Just north of the mouth of Harding Creek

- Where practical, remove intertidal fill to restore/improve natural tidal and sediment transport processes.

- Where practical, remove shoreline armoring or replace armor with alternatives including large woody debris and riparian plantings.

- Prevent installation of intertidal fill and shoreline armoring, prevent removal of native riparian vegetation, and encourage landowners to install community boat ramps, docks, and piers rather than installing structures at each individual property.

- Encourage landowners to minimize disturbance of native riparian vegetation.

- Properly treat stormwater and wastewater to protect water quality.

- Reduce impervious surfaces and minimize the installation of additional impervious surfaces to reduce water pollution caused by stormwater runoff and reduce the impacts of high winter flows and low summer flows caused by reduced infiltration of precipitation.

- Remove unused creosoted pilings.